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A Framework of Performance Measurement System for Manufacturing Company

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In the current dynamic environment, measuring a company's performance becomes exceedingly complex since Performance Measurements Systems (PMS) not only measure a company's performance but also reflect their organizational culture and philosophy. Designing and implementing PMS is an integral part of management control systems. However, traditional PMS are criticized for being obsolete, irrelevant to managerial decision making, unrelated to strategic objectives and detrimental to organizational improvements. Given the shortcomings of traditional PMS, there is need for a new framework that can lead to the design of a PMS that balances short-term and long-term measures, internal and external measures, and financial and operational measures. This paper presents issues associated with the needs of a dynamic PMS, observe past research achievements in PMS and review past PMS frameworks that have been introduced. The paper then proposes an improved methodology for the design of a realistic PMS and its effective implementation in a manufacturing environment with case for Indonesia's company.

***Keywords**: Performance measurement system, benchmarking, Indonesian manufacturing company*

Introduction

In the current dynamic competition, companies realize the intense need of Performance Measurement Systems for managing their performance compared to their competitors. Since Skinner (1969) published his research related to that matter, there are no solid findings and conclusion for which performance measurement should be implemented as changing of financial performance measurement method, such as balanced sheet and income statement. Skinner (1969) argues the importance of aligning corporate strategy with the capabilities of the manufacturing function. Generally companies state their strategy in their mission statement. Many companies have a powerful mission statement but frequently do not know whether that mission is deployed throughout the organization. Management spends a lot of time developing mission statements, but often gets diverted from the details of developing a set of performance measures. Performance measures should drive the strategy throughout the or-

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ganization so that everyone in the organization understands what the strategy is and how their work and their performance are linked to that overall strategy. The absence of this linkage is that stated by Skinner (1969) as the 'missing link' in manufacturing strategy and his arguments did not get response from academician as well as practitioners for long time until 1980. In the late 1980's, Skinner's view provided the trigger for quite a lot of research into manufacturing strategy. This is because of several reasons including the loss of Western companies' market shares to global competition, declining profits, recession and the ascendancy of the Japanese and other Pacific Rim competitors. All these symptoms provided the motivation for seeking new ideas and approaches to managing industry. In Indonesia, the need of such performance measurement is more intense because the difference environment they meet compare to the companies in the world that can not be fulfilled satisfactorily by previous research findings. Some previous framework such as the Balance Scorecard (Kaplan and Norton, 1996), the Performance Prism (Neely et al., 2002), and other approaches still need to adapt and adjust with the Indonesian's environment. Therefore, this research is vital to fill the gap because it can contribute in providing framework and method in the literature and theoretical foundations and also enrich methods available for practical implementation to increase competitiveness of Indonesian companies. In the current dynamic era of competition, managing and measuring a company's performance becomes exceedingly complex as PMS not only relates to measuring company's performance but also reflects its organizational culture and philosophy and describes how well the company performs in terms of financial and non-financial indicators. PMS is viewed as one of those management philosophers that would give significant benefits, including:

a. Satisfying customers
   By having PMS that focuses on customer satisfaction, companies keep their long life business and competitiveness. Without a continual drive towards customer satisfaction, the company will not know the product characteristics or service elements necessary to remain competitive.
b. Monitoring progress
   The right performance measures make process improvement not just possible but continuous. A company that can make a better product (that is one more suited to customers' needs and wants), in less time for less cost, is bound to succeed.
c. Benchmarking processes and activities
   Performance measures make possible 'management by facts'. They should provide the information needed to focus on the best processes and allow comparisons between companies. By having a PMS, a company will know its position relative to its competitors.
d. Driving Change
   The right performance measures help organizations change successfully because they break down barriers and in many cases prevent barriers. This is because performance measures facilitate communication within a process and throughout the whole organization.

The achievement of those benefits needs appropriate designing and implementing of a PMS. To be effective, performance measures need to reflect the changes in competitiveness, but traditional PMS that are mostly depend on the financial performance and reports are criticized for being obsolete, irrelevant to managerial decision making, unrelated to strategic objectives, too late, too aggregated, and detrimental to organizational improvements (Medori, 1998; Kaplan and Norton, 1996). Given the shortcomings of traditional PMS, it is clear that a new PMS framework is required,

which balances short-term and long-term measures, internal and external measures, and financial and operational measures. The challenging research questions would then be: (1) Is there any framework appropriate for certain companies in managing their competi-tiveness? (2) Can the framework be appropriate specifically to certain types of companies or even for certain countries? (3) Can the previous research achievements be implemented to the Indonesian environment?

Literature Review

A core research issue in the area of manufacturing strategy has concerned the establishment of PMS (Dixon et al., 1990; Kim and Arnold, 1996). Hronec (1993) defines PMS as the 'vital signs' of an organization that tell the people in an organization what and how they are doing and whether they are functioning as part of the whole. However, Ljungberg (1994) introduces another definition of PMS that more concise and practical as "*a set of related measures-described by rules and procedures for capture, compilation, presentation and communication of data-that in combination reflect key performances and characteristic of a selected process effectively enough to allow intelligent analysis leading to action if needed."*

The main theme of previous research was the inability of accounting based measurement to accommodate the current needs of production systems. Medori (1998) and Cooper et al. (1992) for example, describe the disadvantages of traditional financial PMS.

Non-financial performance measures are becoming of greater importance because of increased interest being shown in them at the higher management levels (Stoop, 1996). At the operational management and shop floor levels, non-financial performance measures are more relevant than financial measures. Although financial measures capture the monetary consequences of operational performance, they are too broad to help managers cope with such daily decisions as resource allocation and job scheduling.

Even though many authors agree on the need to use more non-financial measures of performance, there appears to be little agreement on precisely which measures to use. This lack of consensus can be explained, in part, by the following reasons. *First*, the obvious need for each company to use measures that are relevant to its own situation. *Second*, there is a lack of clear operational manufacturing strategy, together with some measure of their degree of focus. *Third*, there is shortage of survey-based empirical works that show the linkage between performance measurements at different levels (Ahmed et al., 1996). The problem in selecting non-financial measures, to some extent, can be overcome by utilizing a performance measurement framework. There have been a number of frameworks that have been promulgated over the last periode, for example, *The Malcolm Baldrige National Quality Award (MBNQA) by United States government (Wibisono, 2006), SMART* (Cross and Lynch, 1989); *Performance Measurement Questionnaire (PMQ*) by Dixon et al., (1990); *Performance for World Class Manufacturing (PWCM)* by Maskell (1991); *Quantum Performance Measurement Model (QPMM)* by Hronec, (1993); *Key Performance Indicators (KPI)* by AusIndustry (1995); *The Balanced Scorecard (BSC)* by Kaplan and Norton (1996); and *The Performance Prism* (Neely, 1999).

All the above frameworks have their relative benefits and limitations. The mapping of previous PMS frameworks and comparison amongst them with the present model is illustrated in Appendix 1. It can be seen that there are fourteen different research aspects that have been compared

amongst previous frameworks. The most common limitations of the previous frameworks are: *First*, there is little or no consideration given for existing measurement systems that companies may have in place (Medori, 1998; Neely et al., 1994). *Second*, all the provided frameworks have not been supported by a Knowledge-based/Expert System approach, therefore giving difficulties in consistent implementation. *Third*, even though the benchmarking process has been stated as the one of the most important procedures on managing performance, the mechanism on how to conduct that process and the standard for each performance variables have not been provided. *Fourth*, the improvement recommendations for each poor performance have not been formulated explicitly.

There are several approaches practiced in the world, including Indonesian companies, such as the Balanced Scorecard, The Performance Prism, The Baldrige Approach, The Six Sigma and others. However there is still a lag especially in practicing and contextual of that approach to the Indonesian environment. Some companies, like PT. Telkom and PT. Pertamina, are even confusing because there are so many performance approaches they knew and implemented in running their business and then they abandoned it because it did not give valuable value added or at least in practicing this approach then tend to corrupt to the certain level of management interest.

Research Method

The methodology used in conducting this research is combining theoretical study with model validation from Indonesian manufacturing industries. The theoretical study showed, there are nine important aspects that should be considered in designing PMS for a manufacturing environment: (1) determining a PMS framework, (2) identify company environment, (3) formulating company's statements, (4) analyzing current implemented PMS, (5) determining performance variables, (6) determining cause-effect amongst variables, (7) determining performance standards, (8) determining improvement priority, and (9) formulating recommendations and model evaluation. All nine aspects could be conducted more accurately, consistently and concisely if supported by a Knowledge-based/Expert System approach. The model then tested it's validity through interviews and field survey in the manufacturing industries in Indonesia. We conduct Focus Group Discussions (FGD) with 10 big manufacturing companies in Indonesia. Each company consists of several experts (10-15 people in each company) to validate the knowledge-based practice in their company, appropriateness of key performance indicators they have implemented as well as the suitability of that indicators, the benchmarking of each indicators and the linkage that are exist amongst indicators. Since the data needed to that validation is for whole company performance, so key persons needed to be included are board of director and managers in the related areas such as department of finance, production, marketing, enginee-ring, and human resources. After vali-dation of the framework and related data needed is completed, then the second FGD is conducted to improve the software composing and finally, the third FGD is conducted to finalize and validate the proposed model includes trial for their current data.

Result and Discussion

Determining PMS framework

The first important step in designing a PMS is determining which PMS framework should be implemented in the company. It is deemed prudent and right to use previously good practices for the design of the

present PMS. For example, the Balanced Scorecard (BSC) of Kaplan and Norton (1996) is the most popular PMS framework implemented around the world and is taken in classifying performance perspectives. In manufacturing, for example, rather than using the four perspectives of the BSC, in this research, five level performances are used: financial perspectives, customer perspectives, manufacturing competitive priorities, internal process and resource availability. In determining which perfor-mance variables should be used in each level and the reasons for choosing those variables, one could refer to the *Performance Prism* (Neely, 1999) as an important resource even in this resource, the most appropriate variables should be chosen since there are around 280 variables that are provided and not all suitable for the certain manufacturing company. For analyzing whether the current PMS implemented is aligned with the company vision and mission, one can apply the analysis provided by Dixon at all (1990) in their *Performance Measurement Questionnaire* approach.

Identifying company environment

The different company's product, market, competitors, employee size, and business life cycle stage need varying improvement strategies and therefore different PMS. Analyzing the type of industry where the manufacturing is operating, the number of employee that is currently working and the business prospects of that manufacturing are becoming foundations for determining performance variables and performance standards in PMS.

Formulating company statements

Most of corporate strategists agree that PMS should be derived from the company vision, mission and objectives. Therefore in the proposed model, the existing company statements are analyzed through a systematic procedure. The company mission should be derived and aligned with the company vision. The mission then becomes the foundation in developing company objectives, from which the performance variables are determined.

Analyzing current PMS implemented

The PMS are becoming standard for most manufacturing companies. However, the problems encountered by most practitioners are how can they analyze the existing implemented PMS rather than designing from scratch. It is therefore, important that the existing PMS procedures are analyzed and use as feed back to the design of the new PMS.

Determining performance variables

Determining performance variables is the most crucial step in designing a PMS. There are potentially a very huge number of performance variables that could be used. The choice of the variables provided should be based on the optimization between the degree of importance and practical aspects as it is not possible to use all the performance variables because it would be costly, time consumed and need a big effort.

Determining cause-effect

The linkage amongst performance vari-ables in the different performance levels is crucial in determining performance improvement. The linkage amongst the performance variables can be formulated through analyzing of company's previous performance as well as management judgement. These mechanisms can be determined through implementation of the Analytic Hierarchy Approach/AHP (Saaty, 1980) if there is not enough data provided by companies or it can be using factorial

analysis and analysis of correlation based on the companies' real data.

Determining performance standards

Benchmarking is another important aspect that should be considered and implemented within a PMS. There are two types of benchmarking processes that should be accommodated in the PMS: *internal* and *external* benchmarking. The benchmarking exercise is mainly for diagnosing whether the performance is leading or lagging against the standards. The benchmarking process in the proposed model is based on the GAP (Gauging Absence of Prerequisite) analysis approach proposed by Kochhar et al (1991), which not only determines the GAP between the ideal and the present, but also indicates what needs to be done to bridge the GAP. The standards of performance for each variable also have to be analyzed compare to the internal standard and external benchmarking appropriately to each performance indicator.

Formulating recommendation

Measuring performance without any follow up or improvement action is not beneficial (in fact it may lead to the opposite result) in increasing manufacturing competitiveness. Therefore, it is important to provide recommendations for each lagging performance against standards. The recommendation should be based on the input of experts and experiences of that company in running their productions.

Model evaluation

PMS is a dynamic process that has to be reviewed regularly, based on the latest information and any environmental changes. It is therefore necessary to regularly review the company's operating environment, both internal and external. The model evaluation can be varied based on the level of performance. Evaluations at the shop floor level could be more frequent compared to the strategic level so that the company response is not delayed. Figure 1 shown below illustrates the performance variables chosen for managing this review process.

From Figure 1, it can be seen that there are five levels proposed for managing the performance of a manufacturing company. Level 1 is *Financial Perspective* that consists of four main performance variables namely *Leverage, Liquidity, Profitability*, and *Return on Investment* (ROI). With the exception of ROI, each main performance variable includes several sub-variables that basically represent financial ratio such as Debt Ratio, Cash ratio and Net Profit Margin.

Level 2 is about *Customer Perspective* and consists of three main variables namely *Customer Satisfaction, Customer Loyalty* and *Customer Acquisition*. The most appropriate method to manage these variables is through conducting customer survey activities. Hence, in the proposed model the mechanism for checking *Customer Perspective* is through analyzing commitment, planning, implementation and evaluation of the company's concern.

Level 3 is about *Manufacturing Competitive Priorities* that impact on managing manufacturing performance in terms of quality, flexibility and delivery. This level contains five variables to determine the priorities: customer claims, product returns, lost sales, back order and on time delivery.

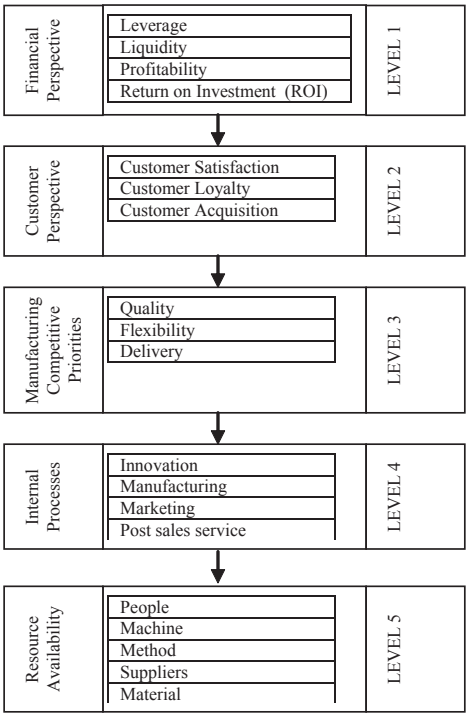
Level 4 is about managing *Internal Processes* which consists of four main categories: *Innovation, Manufacturing Process, Marketing* and *Post Sales Service*. Each category consists of several performance variables such as new product development and R & D spending for *Innovation* category; reject and rework rate for *Manufacturing Process*; promotion, advertising and distribution for *Marketing* category; and quality

of service for *Post Sales Service* category. In total, there are about 20 variables that are included in the *Internal Process*.

Level 5 is about *Resource Availability* which is divided into five main categories namely *People, Machine, Method, Material and Supplier*, in which each category consist of several performances variables. There are more than 25 variables included in the *Resource Availability* as a whole.

It can be seen from Figure 1, that even though it seems that there is a hierarchical and procedural method from the level 1 (Financial Perspective) to level 5 (Resource Availability) in composing the linkage amongst performance variables, in practice the actual measurement can be done simultaneously. However, differences exist in the response time needed between levels. While the measurement and analysis of the performance result for level 5 can happen more frequently such as weekly or monthly, the measurement and analysis of the performance result for level 1 usually happens annually or at least quarterly.

Figure 1. Proposed Variables for Managing Manufacturing Company Performance



The figure 1 shows the result of input from the Indonesian companies on how the industries can manage themselves and compete globally. It is modified from the Balanced Score Card method that consists of four perspectives, with emphasis on the manufacturing competitive priorities that are quality, flexibility and delivery.

The choosing of performance variables and how to implement it to the certain environment is of crucial important in the PMS. This is can be based on the statistical data of companies by conducting factorial analysis and analysis of correlation. By doing these two statistical data it can be drawn which variables of companies in the each perspective that most influence of the performance and appropriate to be implemented. However, not many Indonesian companies have such kind of data, to do so, it can be using AHP to choose the suitable variables based on assumption that these information are discussed to the expert ones in that companies. Table 1 illustrates the example summary of analytical performance variables that are proposed in the PMS model.

Conclusion

This paper has described the importance of having dynamic PMS to improve manufacturing competitiveness, observe research achievement in the past PMS, and analyze previous PMS frameworks. It has also discussed the important issues in designing appropriate PMS for manufacturing company.

Basically, there are nine important factors that should be included in designing PMS for a manufacturing: determining PMS framework, identify company environment, formulating company statement, analyzing current PMS implemented, deter-

mining performance variables, determining cause-effect amongst variables, determining performance standards, determining improvement priority, formulating recommendations, and model evaluation. By implementing the approach suggested in this paper, one could combine any benefits from several frameworks and design a tailor made PMS for a company.

The new aspects of the proposed PMS model as compared to the previous framework are: *First*, the proposed model is supported by Knowledge-based/Expert System approach. *Second*, the benchmarking process and performance standards are provided explicitly for each performance variable based on the GAP analysis. *Third*, the model is pro-active by providing a list of recommendation for improvement. *Fourth*, the software provided in the model makes the mechanism of implementation much easier, more accurate, and more consistent and provides a recommended list of actions to improve the performance.

The contribution of the paper is to provide PMS that most appropriate to Indonesian manufacturing companies where by using previous frameworks such as the BSC, The Performance Prism and others, companies still need to make further improvisation start from defining variables, establishing standard, defining linkage among performance variables and to follow up of the recommendations. Based on the Knowledge-Based system, Factorial and Correlation Analysis, GAP mechanism, the practitioners can improve their companies' competitiveness real time and based on the data.

Table 1. Example Summary of Analytical Performance Variables for a Manufacturing Company

Perspective	Indicator	Term	Formulation
Financial	Leverage	Debt Ratio	$\frac{\textit{Long-term debt + value of leases}}{\text{Long-term debt +value of leases + equity}}$
	Liquidity	Cash Ratio	$\frac{\text{Cash + Short-term securities}}{\text{Current liabilities}}$
		Net Profit Margin	$\frac{\text{(EBIT – Tax) x 100}}{\text{Sales}}$
	Others	ROI	$\frac{\text{Net Profit x 100}}{\text{Total Capital Employed}}$
Customer	Customer needs	Customer satisfaction	Customer satisfaction survey
		Customer loyalty	% of orders/ sales turnover which are from existing customer
		Customer acquisition	Number of New Customer
Manufacturing Competitive priorities	Quality	Customer claims	$\frac{\text{Number of product complaints}}{\text{Total products}}$
	Flexibility	Lost sales	$\frac{\text{Number of order could not be fulfilled}}{\text{Total order}} \times 100\%$
	Delivery	On time delivery	$\frac{\text{Number of product delivery on time x 100\%}}{\text{Total product}}$
Internal process	Innovation	New product development	% number product of obsolescence
	Manufacturing	Reject rate	Parts per million defective
	Marketing	Advertising vs. Sales turnover	$\frac{\text{Expenditure for Advertising}}{\text{Sales turnover}}$
		Promotion vs. Sales turnover	$\frac{\text{Expenditure for promotion}}{\text{Sales turnover}}$
	Post sale service	Quality of service	% of faults/ complaints that are satisfactorily resolved first time
Resource availability	Man	Employee qualification	Average number of employees with the appropriate professional/ trade qualification
	Machine	Age of technology	Average age of technologies
	Method	PMS implementation	False alarms and Gaps
	Material	Inventory Capabilities	Inventory turnover
	Supplier	Quality	$\frac{\text{Number of product accepted}}{\text{Total product supplied}} \times 100\%$

It has been known for almost fifteens years that the previous approaches such as the Balanced Scorecard, the Performance Prism, the Baldrige Approach, are most popular method in managing companies performance management. However, in practice, many companies in Indonesia is having difficulties to implement them because the methods still requires further adjustments. It could be that for some extent the imported PMS designs are not contextual to their needs. Therefore, this paper gives an alternative to the more practical and systematic approach for Indonesian manufacturing companies to increase their competitiveness.

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Appendix 1. Mapping of Previous PMS Frameworks and Proposed Model

Research aspect	SMART	PMQ	PWCM	QPMM	BSC	Prism	Proposed Model
Procedure to design PMS	General overview	Stated Explicitly	General overview	Stated explicitly	Stated explicitly	General overview	Explained Explicitly
Design of PMS (e.g. framework, example, suggestion)	One distinct model	Framework	No	One distinct model	Explicit examples from empirical companies' data	Framework and distinct model	Framework and distinct moel
Levels/ perspectives	4 levels	2 perspectives	Not described explicitly	3 perspectives	4 perspectives	5 perspectives	5 perspektives
Formulation of suggested performance variables	General term	General term	General term	Some in general terms, the others in detail	General term supported by detailed formulation on variables implemented by certain company	Detailed formulation on each variable	Detaoled formulation on each variables
Consideration of current PMS implemented by company	No	Yes	No	No	No	No	Yes
Purpose to be implemented in	Manufacturing and service company	Manufacturing	Manufacturing	All types of industry	All type of industry	All type of industry	Manufacturing Industry in Indonesia
Number of performance variables suggested	10 General variables	Around 65 individual performance variables	Around 15 general variables	Grouped in 26 categories, each category consists of several flexible number of variables	Grouped in 4 big perspectives, each perspective could consist of several variables depending on company managed	More than 200 individual performance variables	Grouped in 5 perspectives, each perspectives consist of related several variables
Reasons on choosing variables	General overview	General overview	General overview	Stated explicitly on perspectives frame	Stated explicitly on each perspective frame	Stated explicitly for each variable	Stated explicitly for eacg variables in kowledge based
Knowledge-based approach	No	No	No	No	No	No	Yes
Supported by software	No	No	No	No	No	No	Yes
Benchmarking process	Not discussed explicitly	Not discussed explicitly	Not discussed explicitly	Some performance standards are overviewed in general	The procedures of benchmarking are discussed conceptually, but the standards are not provided for each performance variable	Benchmarking procedures are not discussed explicitly, some performance standards provided	Performance standard are overviewed and stated explicitly
Linkage amongst variables of different management levels	Established distinctly	No	No	Established distinctly	Established in the frame of perspectives provided	Established distinctly	Established distinctly
Method to judgement linkage and improvement priorities	Not provided	Not provided	Not provided	Not provided	Not provided	Not provided	Using Factorial Analysis & Correlation method
Improvement recommendations	Not provided	Not provided	Not provided	Stated implicitly in discussing model	Stated explicitly in the examples provided (empirical data)	Stated implicitly in each variables suggested to be measured	Stated explicitly

*Note: SMART = Strategic Measurement Analysis and Reporting Technique; PMQ = Performance Measurement Questionnaire; PWCM = Performance for World Class Manufacturing QPMM = Quantum Performance Measurement Model; BSC = The Balanced Scorecard